260157

FLOOD INSURANCE STUDY

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TOWNSHIP OF WHITEFORD, MICHIGAN

MONROE COUNTY

OCTOBER 1, 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 260157

FEMA 209

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PUBLISHED SEPARATELY:

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Flood Insurance Rate Map

FLOOD INSURANCE STUDY

TOWNSHIP OF WHITEFORD, MONROE COUNTY, MICHIGAN

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Whiteford, Monroe County, Michigan, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert the Township of Whiteford to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by McNamee, Porter and Seeley/Smith, Hinchman and Grylls Associates for the Federal Insurance Administration, under Contract No. H-4705. This study was completed in November 1979.

1.3 Coordination

Streams requiring detailed study were identified at a meeting attended by representatives of the Study Contractor, the FIA, and the Township of Whiteford in March 1978. Results of the hydrologic and hydraulic analyses were coordinated with the Michigan Department of Natural Resources, Water Management Division (MDNR), which is the designated State Coordinating Agency.

During the search for pertinent data, contacts were made with the Township of Whiteford, the MDNR, the Ohio Department of Natural Resources

(ODNR), the U.S. Army Corps of Engineers (COE), the Soil Conservation Service (SCS), the U.S. Geological (USGS), the Michigan Department of Transportation (MDOT), and the Monroe Evening News.

On May 5, 1980, the results of the work by the Study Contractor were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor and the FIA and community officials.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Whiteford. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through November 1984.

Approximate methods of analysis were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the FIA and the Township of Whiteford.

The flooding sources studied by detailed methods are listed below:

a. North Ten Mile Creek, from the southern corporate limit (also the Michigan-Ohio state line) to 80 feet upstream of northbound U.S. Highway 23; and

b. Halfway Creek, from the eastern corporate limit to 450 feet upstream of Sterns Road.

The streams studied by approximate methods were Schreiber Ditch, Hind Drain and its unnamed tributaries, McPeek Drain, Drain No. 10 and its tributaries, Waffle Drain, North Ten Mile Creek, Smith Ditch, Vanpelt Drain, Dalley Drain and its tributaries, Branch No. 1 and Branch No. 2 Drains, Hubbard and Clampitt Drain, Ottawa Lake Outlet, Fox Drain, Gove Drain, Bischoff Drain, Saxton Drain, Cox Drain, McGlenn Drain, Halfway Creek and its unnamed tributary, Montri and Pomeroy Drain, McMeekin Drain, Labadie Drain, and Big Sink Drain. In addition, four ponds (Ottawa Lake Bed, Nobel Pond, Stone Quarry, and an unnamed pond) were also studied by approximate methods.

2.2 Community Description

The Township of Whiteford is located in the southeastern portion of Michigan in the southerly portion of Monroe County. The total land area

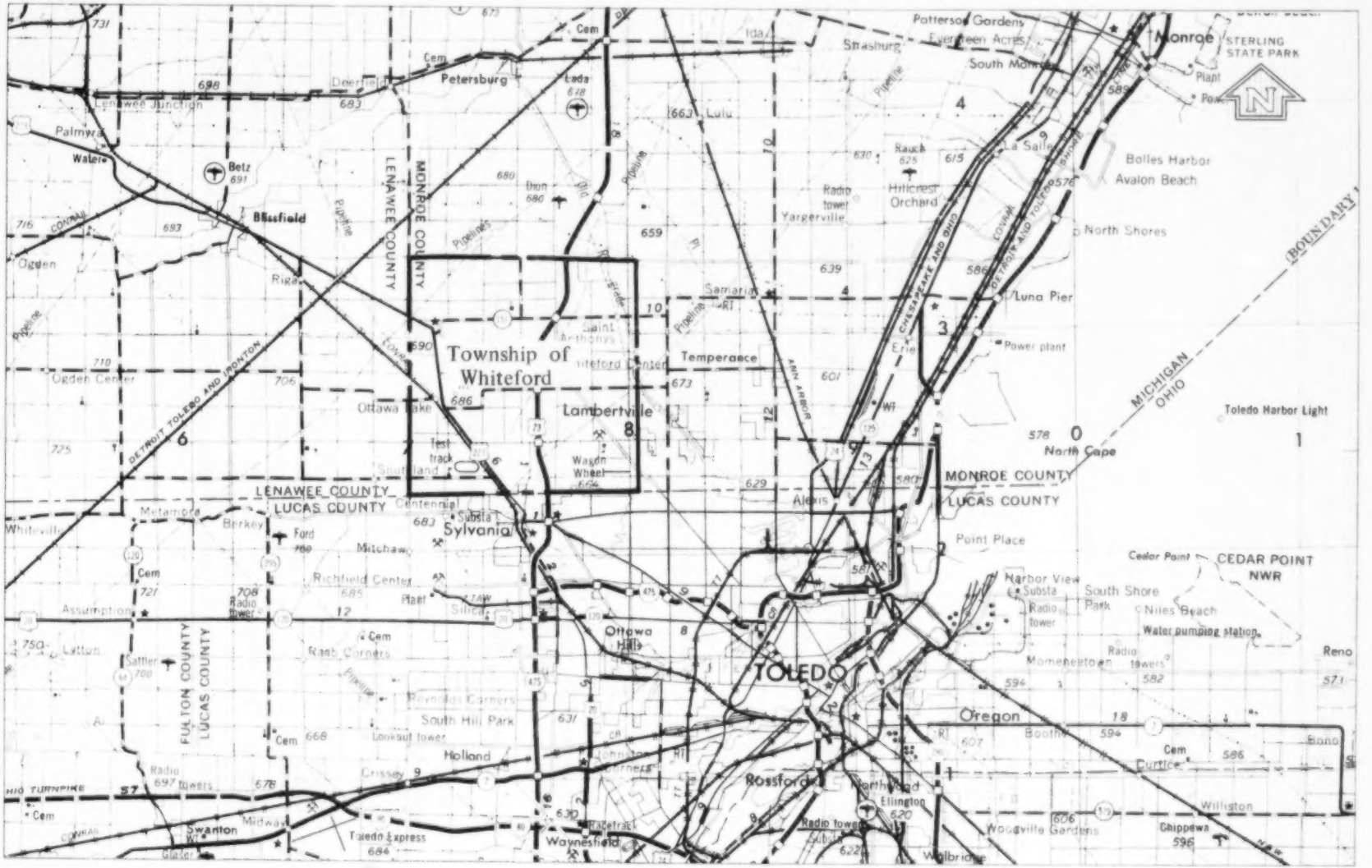


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF WHITEFORD, MI
(MONROE CO.)

APPROXIMATE SCALE
4 0 4 8 12 MILES

VICINITY MAP

contained within the township limits is 36 square miles. It is situated approximately 40 miles southwest of metropolitan Detroit and 10 miles northwest of Toledo, Ohio. The Township of Whiteford is bounded by the Township of Summerfield to the north, the Township of Bedford to the east, the unincorporated areas of Lucas County and the City of Sylvania, Ohio to the south, and the Township of Riga to the west. According to U.S. Census Bureau figures, the population has increased from 4,122 in 1970 to 4,475 in 1975 (Reference 1).

The general climate of the area is one of moderate humidity and temperate weather. The maximum temperature averages about 84 degrees Fahrenheit (F.) in July and minimum temperature averages 22 degrees F. in January. Winds are predominantly from the west and southwest (Reference 2).

The topography of the Township of Whiteford is relatively flat, resulting in the large number of drains which are relatively wide and are generally shallow. Soils in the area vary from silt loams and clay loams to sandy loam over clay (Reference 3).

The Township of Whiteford is primarily a residential-agricultural community. The Comprehensive Development Plan for Monroe County, COMPLAN 2000 recommends development of 50 percent of the eastern areas in the township by 2000 (Reference 3). Development within the flood plain of Whiteford is mostly agricultural.

2.3 Principal Flood Problems

The flooding of the streams within the Township of Whiteford results in crop damage, siltation at bridges and culverts, and flooding of residential-agricultural structures.

2.4 Flood Protection Measures

No flood protection structures have been constructed in the Township of Whiteford and none are planned in the foreseeable future.

Nonstructural measures of flood protection are being utilized to aid in the prevention of future flood damage. These are in the form of land use regulations adopted from the Code of Federal Regulations which control building within areas that have a high risk of flooding (Reference 4).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly

termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten), and for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for North Ten Mile Creek and Halfway Creek. No streamflow data were available on these watercourses, or on any nearby hydrologically similar watercourses, of approximately the same drainage area. Therefore, Brater's method (Reference 5) was used to estimate the peak 10-, 50-, 100-, and 500-year flows. This method considers factors such as: population density, infiltration capacity, and rainfall intensity-duration relationships.

Just downstream of the Township of Whiteford, North Ten Mile Creek flows through the City of Sylvania, Ohio. This portion of the creek has been studied as part of the Sylvania Flood Insurance Study (Reference 6). Halfway Creek flows through the Township of Bedford and the City of Toledo, Ohio. These portions of the creek have been studied as part of the Township of Bedford Flood Insurance Study (Reference 7) and the City of Toledo, Ohio Flood Insurance Study (Reference 8).

Peak discharges for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
NORTH TEN MILE CREEK					
At the Michigan-Ohio border	36.6	1,050	1,530	1,780	2,380
HALFWAY CREEK					
At Secor Road	15.4	640	930	1,080	1,460

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the streams in the community were carried out to provide estimates of the elevations of the floods of the selected recurrence intervals along each flooding source studied in detail.

Cross sections for the backwater analyses of the North Ten Mile Creek and Halfway Creek were obtained from field survey. All bridges, rock dams, and culverts were field checked to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations, were based on field observations of the streams and flood plain areas. Roughness values for the main channel of North Ten Mile Creek range from 0.050 to 0.052 with a flood plain roughness value of 0.065 for all floods. The corresponding roughness values for Halfway Creek are 0.035 to 0.055 for the main channel and 0.040 to 0.10 for the flood plain.

Starting water-surface elevations for the North Ten Mile Creek were developed from a rating curve based on the City of Sylvania, Ohio Flood Insurance Study (Reference 6). Starting water-surface elevations for Halfway Creek were based on the Flood Insurance Study for the Township of Bedford, Michigan (Reference 7). Elevations for the streams studied by approximate methods were determined by using normal depth calculations. Water-surface elevations of floods of the selected recurrence intervals were computed through use of the HEC-2 step-backwater computer program (References 9, 10, and 11). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations as shown on the profiles are, therefore, considered valid only if hydraulic structures, in general, remain unobstructed and if channel and overbank conditions remain essentially the same as ascertained during this study.

All elevations are referenced from National Geodetic Vertical Datum of 1929 (NGVD); elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100-year and the 500-year floods have been delineated using the elevations determined at each cross section; between cross sections the boundaries were interpolated using USGS topographic maps photoenlarged to a scale of 1:12000, with a contour interval of five feet (References 12, 13, 14, and 15). For the streams studied by approximate methods, the boundaries of the 100-year flood were delineated using the USGS topographic maps referenced above.

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to lack of detailed topographical information or to limitations of the map scale, such areas are not shown. In cases where the 100-year and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management.

Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. In Michigan, though, under Michigan Act 245, Public Acts of 1929, as amended by Act 167, Public Acts of 1968 (Reference 16), encroachment in the flood plain is limited to that which will cause only an insignificant increase in flood heights. Thus, at the recommendation of the Bureau of Water Management, a floodway having no more than a 0.1-foot surcharge has been delineated for this study.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

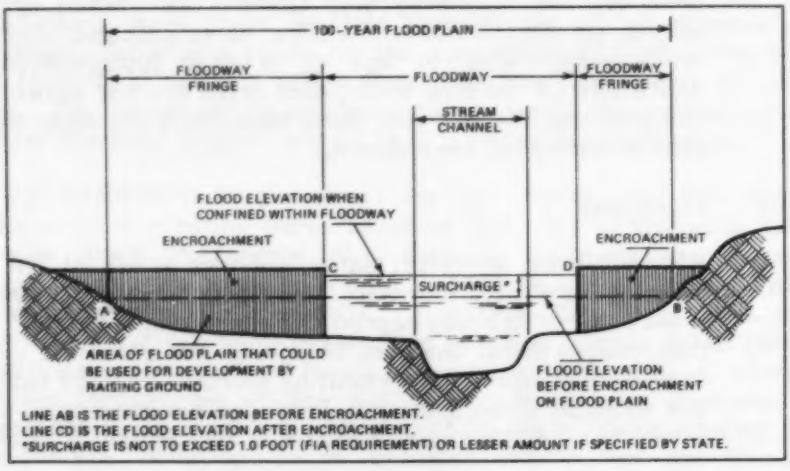

100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE *
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE
NORTH TEN MILE CREEK							
A	0	96	466	3.8	647.6	647.6	0.0
B	1150	120	581	3.1	649.8	649.8	0.0
C	2550	76	333	5.3	653.2	653.2	0.0
D	3600	90	368	4.8	656.5	656.5	0.0
E	3750	43	264	6.7	657.0	657.0	0.0
F	3825	96	489	3.6	657.8	657.8	0.0
G	4000	25	176	10.1	658.1	658.1	0.0
H	4100	122	628	2.8	660.2	660.2	0.0
I	4650	49	365	4.9	660.8	660.8	0.0
J	4825	58	382	4.7	661.0	661.0	0.0
HALFWAY CREEK							
A	0	104	303	3.6	633.3	633.3	0.0
B	1350	45	138	7.8	641.0	641.0	0.0
C	1500	198	355	3.0	642.7	642.7	0.0
D	1550	101	175	6.2	644.7	644.7	0.0
E	2250	121	222	4.9	648.7	648.7	0.0
F	2400	257	267	4.0	655.7	655.7	0.0
G	2450	289	1157	1.0	655.7	655.7	0.0
H	2850	117	440	2.5	655.9	655.9	0.0

[1]FEET ABOVE CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF WHITEFORD, MI
(MONROE CO.)

FLOODWAY DATA

NORTH TEN MILE CREEK - HALFWAY CREEK

The floodways in this report are recommended to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHF), and flood insurance zone designations for each flooding source affecting the Township of Whiteford.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the Township of Whiteford are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Whiteford was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations are shown or FHFs determined.
Zones A2, A3:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations are shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; or areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Whiteford is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
NORTH TEN MILE CREEK							
REACH 1	0010	–1.3	–0.4	0.9	015	A3	VARIES–SEE MAP
HALFWAY CREEK							
REACH 1	0010	–1.0	–0.2	0.7	010	A2	VARIES–SEE MAP

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF WHITEFORD, MI
(MONROE CO.)

FLOOD INSURANCE ZONE DATA

NORTH TEN MILE CREEK - HALFWAY CREEK

6.0 OTHER STUDIES

Flood Insurance Studies for Sylvania, Ohio, the unincorporated areas of Lucas County, and the Township of Bedford are in agreement with this study (References 6, 17, and 7).

A Flood Hazard Boundary Map has been published by the Federal Insurance Administration (Reference 18). The differences between the Flood Hazard Boundary Map and this study are justified due to the more detailed nature of this Flood Insurance Study.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the National Flood Insurance Program.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, One North Dearborn Street, Chicago, Illinois 60602.

8.0 REFERENCES AND BIBLIOGRAPHY

1. U.S. Department of Commerce, Bureau of the Census, Population Estimates and Projections, May 1977.

2. ----------, National Climatic Center, Local Climaticological Data Annual Summary with Comparative Data 1977, Whiteford, Michigan, Asheville, North Carolina, 1978.

3. Monroe County Planning Commission, Comprehensive Development Plan for Monroe County, COMPLAN 2000, August 1967.

4. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Code of Federal Regulations, Title 24, Chapter 10, Parts 1910.3A and 3B, Federal Register, Volume 41, No. 207, (revision) 1976.

5. Brater, E.F. and J.D. Sherrill, Rainfall-Runoff Relations on Urban and Rural Areas, EPA 670-12-75-046, May 1975.

6. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Sylvania, Ohio, January 1977.

7. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Bedford, Michigan, (in progress).

8. ————————, Flood Insurance Study, City of Toledo, Ohio, (in progress).

9. U.S. Army Corps of Engineers, HEC-2 Water-Surface Profiles, Users Manual, February 1972.

10. ————————, Application of the HEC-2 Bridge Routines, June 1974.

11. ————————, HEC Training Document No. 5, Floodway Determination Using Computer Program HEC-2, Vernon R. Booner, May 1974.

12. U.S. Geological Survey, Topographic Map, Scale 1:24000, Contour Interval five feet: Ambertsville West Quadrangle, Michigan, 1972.

13. ————————, Topographic Map, Scale 1:24000, Contour Interval five feet: Blissfield Quadrangle, Michigan 1972.

14. ————————, Topographic Map, Scale 1:24000, Contour Interval five feet: Berkley Quadrangle, Ohio, 1966.

15. ————————, Topographic Map, Scale 1:24000, Contour Interval five feet: Sylvania Quadrangle, Ohio, 1965.

16. State of Michigan, Flood Plain Control Act of 1968, Act 245, P.A. 1928 as amended by Act 167, P.A. 1968, Michigan Water Resources Commission, Lansing, Michigan , 1968.

17. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Unincorporated Areas of Lucas County, Michigan, (in progress).

18. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Whiteford, Michigan, June 1976.

Brater, E.F., and King, Handbook of Hydraulics, 6th Edition. McGraw-Hill Book Company, Inc., 1976.

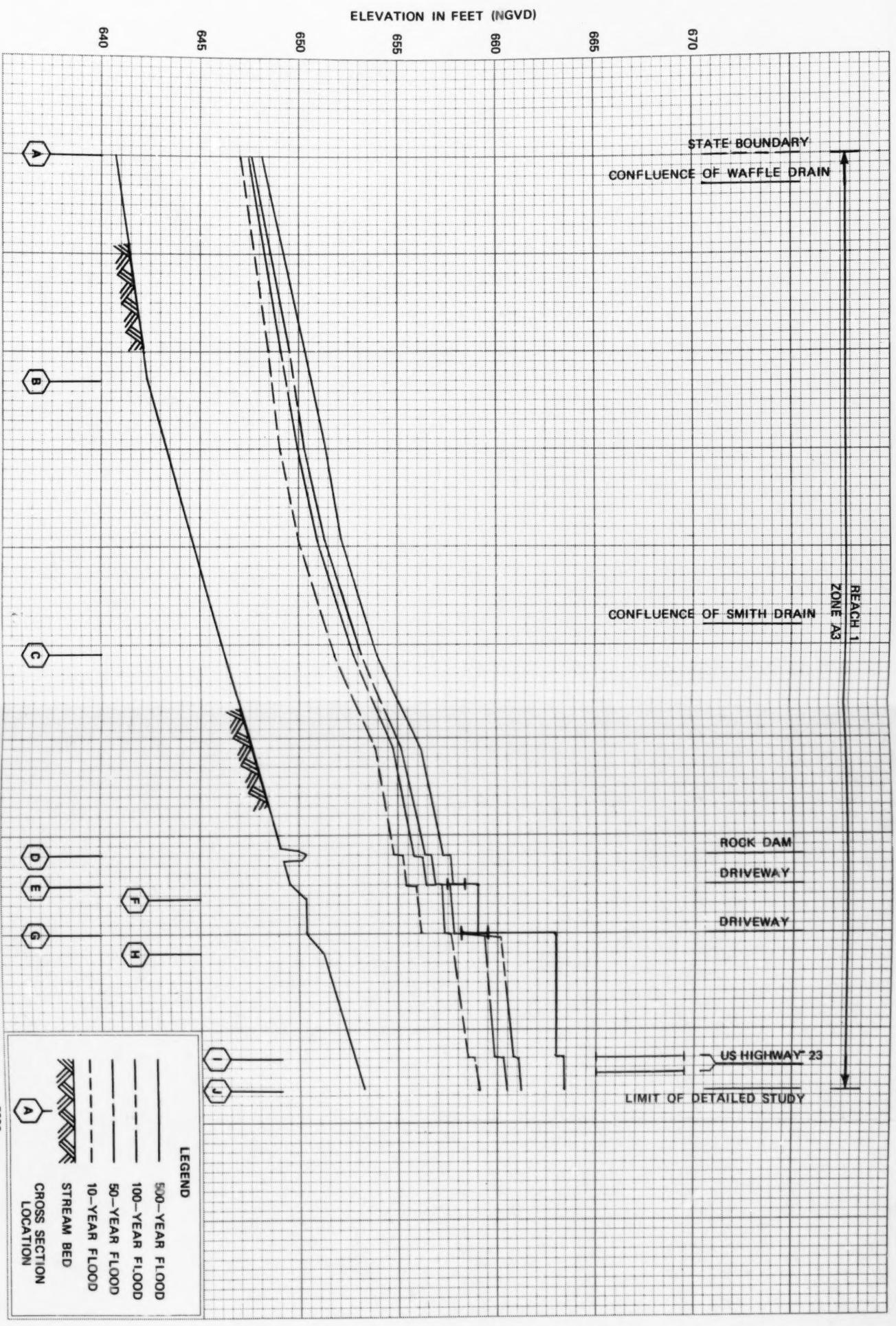
Chow, Ven Te, Open Channel Hydraulics. McGraw-Hill Book Company, Inc., 1959.

Ohio Department of Natural Resources, Bulletin No. 45, Floods in Ohio, Magnitude and Frequency, E.E. Webber and W.P. Bartlett, Jr., May 1977.

U.S. Geological Survey, Water Suppler Paper, Roughness Characteristics of Natural Channels, Harry H. Barnes, Jr., 1849.

————————, Water Resources Division, Water Resources Data for Michigan, Water Year 1977, 1978.

U.S. Water Resources Council, Bulletin No. 17, Guidelines for Determining Flood Flow Frequency, March 1976.

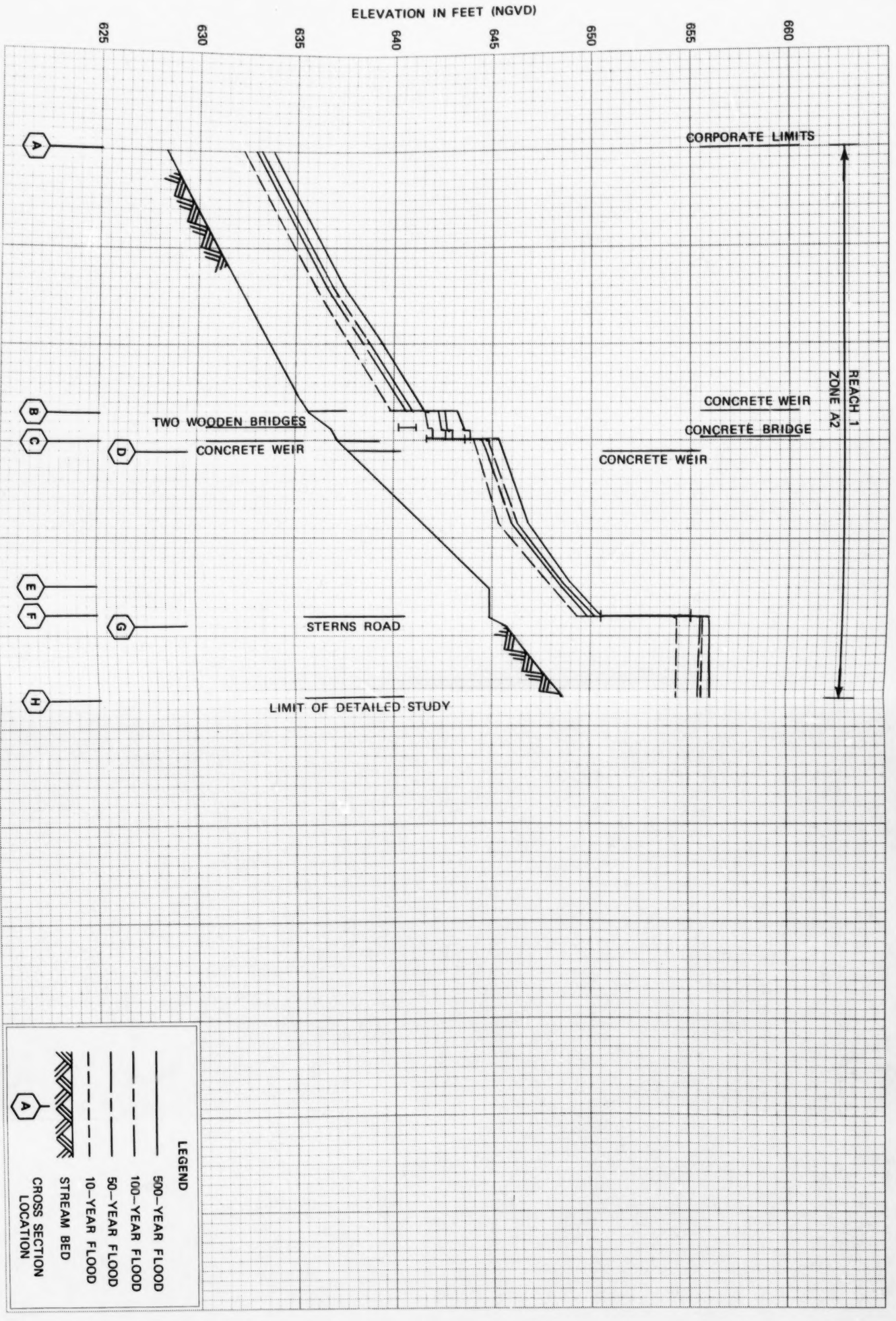


FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration
TOWNSHIP OF WHITEFORD, MI
(MONROE CO.)

FLOOD PROFILES

NORTH TEN MILE CREEK

01P



02P

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF WHITEFORD, MI
(MONROE CO.)

FLOOD PROFILES

HALFWAY CREEK